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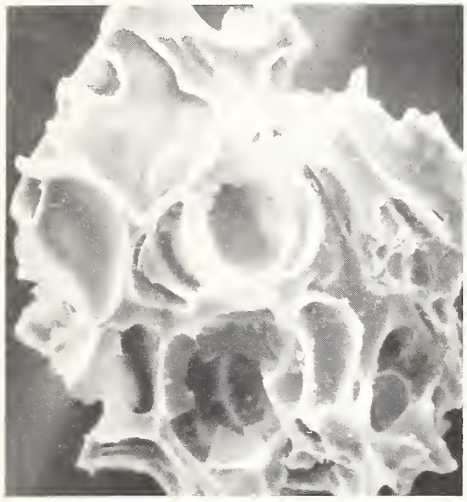

A Mt. St. Helens volcanic glass particle, photographed from a scanning electron micrograph, is 0.10 mm in diameter, several times larger than most of the ash grains.

Volcanic Ash Analysis Continues

by Jerry D. Schwien

One hundred particles on the head of a pin—that gives you an idea of the size of volcanic glass that erupted from Mount Saint Helens in southwestern Washington.

Dr. Steven Holzhey, head of the Soil Conservation Service National Soil Survey Laboratory (NSSL) in Lincoln, Nebr., says the tiny particles are absolutely fascinating.

"Gas bubbles left holes in the ash," said Holzhey. These holes absorb large amounts of water. This, in combination with the particle size and shape, enables 1 pound of Mount Saint Helens' ash to hold ½ pound of water for plant use. A typical silt loam can store only half that amount.

The fine porous particles will weather rapidly in humid climates, release plant nutrients, and form unique noncrystalline clays. The nutrients released should have little impact on major nutrients needed for field crops but may add to the availability of minor elements. The clays fix immense quantities of phosphorus and hold unusual amounts of water. Although the weathering is rapid in a geological time frame, the phosphorus fixation will not be a problem in our lifetime.

Continued on next page.

Energy Security Act Signed into Law

by Nancy M. Garlitz

On June 30, President Carter signed into law a comprehensive energy program to reduce the United States' dependence on imported petroleum and natural gas. The new Energy Security Act, or Public Law 96-294, calls for increased production and use of biomass energy that will not impair the Nation's ability to produce food and fiber for domestic use and for export.

Title II of the new law, entitled the "Biomass Energy and Alcohol Fuels Act of 1980," authorizes a $1.45 billion program to promote production of alcohol and other fuels from biomass, which includes crops and crop residues, timber and timber waste, and animal waste. Under subtitle A of this act, the U.S. Department of Agriculture (USDA) and the U.S. Department of Energy (DOE) Secretaries are authorized to each distribute $600 million in the next 2 fiscal years in loans, loan guarantees, price guarantees, and purchase agreements to producers of fuels from biomass resources.

Facilities that use agriculture and forestry resources and are expected to produce less than 15 million gallons of alcohol fuels per year will receive their aid from USDA. Projects producing 15 million gallons or more a year using forestry or agricultural resources and owned and operated by cooperatives could be funded by either agency, subject to concurrence by the other agency. All other plants producing 15 million gallons or more per year would be the responsibility of DOE.

The Secretaries of USDA and DOE must submit by January 1, 1982, a plan for achieving a production level of at least 60,000 barrels a day of alcohol by the end of 1982. The goal for 1990 is that alcohol fuel production equal at least 10 percent of domestic gasoline consumption.

Title II of the new law also authorizes USDA to establish not more than 10 model demonstration biomass energy facilities around the country. The models will demonstrate new technology for using a variety of agricultural and forestry feedstocks to produce biomass energy. The facilities will be established in cooperation with other State and Federal agencies. The act authorizes $5 million for each fiscal year from 1981 to 1984 to USDA for development of the facilities.

Title II authorizes $12 million for USDA (also for each fiscal year from 1981 to 1984) to grant to colleges, universities, and government corporations such as the Tennessee Valley Authority for biomass energy research and demonstration projects. And it authorizes $10 million for the same time period for USDA to provide to State directors of extension programs for biomass energy educational and technical assistance pro-

Continued on next page.

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Volcanic Ash Analysis, cont.

The NSSL is studying the ash samples to be certain there are no high concentrations of toxic elements. So far none have been found.

"There was some concern that sulphur in ash deposits might produce strong acids," said Holzhey, "but this has not been a problem."

There are sufficient sulfates and chlorides to produce large amounts of acids, but tests at the NSSL show that one-third or more is already neutralized by calcium, magnesium, and sodium. Lab testing produced only minor acidities equal to that of a carbonated drink.

Much of the sulphur will convert to gypsum (calcium sulfate), which may benefit some crops in humid areas, and will be generally harmless elsewhere. Quantities equal to 500 pounds of gypsum per acre inch of ash have already formed in some areas.

Another byproduct forming in the ash samples is sodium chloride, the component of table salt. More than 500 pounds per acre inch has been measured in the ash. The salt is generally insignificant through most of the fallout area, but could be tasted in the first water flushing through thick ash deposits.

Fluorides, another concern in some volcanic deposits, have not been found in large amounts thus far although careful studies continue.

The study of soils influenced by volcanic ash is not new at the NSSL. The laboratory is currently working with an international group to study volcanic ash soils. The SCS lab has several hundred samples from Nebraska, Hawaii, Alaska, the American Southwest, California, the Pacific Northwest, and foreign countries. Experience from these earlier studies is being applied to the Mount Saint Helens' situation.

The U.S. Department of Agriculture and other Federal and State agencies will continue studies in the affected region to discover the presence of any substances potentially hazardous to agriculture and water quality, according to Holzhey.

Jerry D. Schwien,
head, Information Staff, Midwest Technical Service Center, SCS, Lincoln, Nebr.

Energy Security Act, cont.

grams. USDA will cooperate with the State directors of Extension, land-grant universities, State foresters, and heads of other Federal agencies to provide educational programs for producers of agricultural commodities and wood and wood products to disseminate research results and provide technical assistance.

The Secretary of Agriculture will consult with councils and boards dealing with agriculture in coordinating the applied research and extension programs conducted under Title II of the Energy Security Act.

The Farm Credit Administration will encourage production credit associations, Federal land banks, and banks for cooperatives to use existing authorities to make loans to eligible persons for commercially feasible biomass energy projects.

The new Energy Security Act amends the Soil Conservation and Domestic Allotment Act to provide for energy conservation cost sharing through the Agricultural Conservation Program. Through the amendment, the Secretary of Agriculture may provide financial assistance to agricultural producers to encourage energy conservation by sharing the costs of and providing technical assistance for: the establishment, restoration, and better use of shelter belts to conserve energy on farmsteads and feedlots; the establishment and use of minimum tillage systems; the efficient storage and application of manure and other suitable wastes to the land for land fertility and soil improvement; the use of integrated pest management; the use of energy-efficient irrigation water management; and such other land, water, and related resource management practices as the Secretary may determine to have significant energy-conserving effects.

One section of Title II amends the Food and Agriculture Act of 1977 to permit production of any commodity on set-aside or diverted acreage that is converted into alcohol. Another section authorizes the Secretary of Agriculture to make available the timber resources of the National Forest System, in accordance with appropriate timber appraisal and sale procedures, for use in biomass energy projects.

Title II also requires USDA and all Federal agencies that own or lease motor vehicles capable of using gasohol, to use gasohol where it is available at reasonable prices and in reasonable quantities.

Title IV of the law, cited as the "Renewable Energy Resources Act of 1980," establishes under DOE a 3-year, pilot, energy self-sufficiency demonstration program using renewable energy resources in one or more States. Renewable energy resources include direct and indirect solar radiation and wind, ocean thermal gradients, ocean currents and waves, hydropower, photovoltaic energy, vegetation, organic wastes, and others.

Bob Bergland
Secretary of Agriculture

Norman A. Berg, Chief
Soil Conservation Service

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Comments:

from the SCS Chief

Many USDA agencies, including the Soil Conservation Service, will play a role in meeting the objectives of the new Energy Security Act, which was recently signed into law (see article beginning on page 1).

In brief, some of the areas in which SCS may become involved include providing technical assistance in:

- managing biomass, which includes crops and crop residues, timber and timber waste, and animal waste;
- identifying opportunities for constructing small-scale hydropower projects and monitoring atmospheric deposition such as acid rain;
- establishing, restoring, and improving shelter belts on farmsteads and feedlots;
- establishing conservation tillage systems;
- planning efficient storage and application of manure and other suitable wastes to the land for land fertility and soil improvement;
- determining land suitability for certain "energy" crops;
- determining how much crop residue for alcohol production can be taken off the land while leaving the land adequately protected;
- designing waste management systems for agricultural operations that are readily adaptable to producing methane—changing waste management systems into energy production systems.

Most of the production of ethanol and methanol from renewable organic matter to make gasohol is going to come from the rural sector. SCS already has a firmly established working relationship with rural citizens, primarily through local conservation districts.

As we strive to stay abreast of new developments in energy technology, we must continue to provide the best in technical assistance to conserve our Nation's land, water, and related resources.

Title IV also includes small-scale hydropower initiatives. It amends the Federal Power Act to include projects which use natural water features for the generation of electricity, without the need for any dam or impoundment and which do not harm the environment.

The section entitled "Acid Precipitation" in Title VII establishes a 10-year research program to identify the causes and effects of acid precipitation and to identify ways to reduce or prevent its harmful effects on water quality, agricultural and forest crops, fish and wildlife, public health and welfare, and construction materials.

The task force will be jointly chaired by the Secretary of Agriculture, the Administrator of the U.S. Environmental Protection Agency, and the Administrator of the National Oceanic and Atmospheric Administration (NOAA). The NOAA administrator will direct the research program. The act authorizes up to $50 million for the program.

The acid precipitation task force agenda will include: establishing a nationwide monitoring network to detect and measure levels of acid precipitation; defining affected geographic areas through deposition monitoring; and collecting existing data on water and soil chemistry.

Several USDA agencies, including SCS, and many other Federal, State, and local governments and private agencies will be involved in meeting these and other mandates of the new Energy Security Act.

Nancy M. Garlitz,
associate editor,
Soil and Water Conservation News,
SCS, Washington, D.C.

News Briefs

Kansas Achieves Milestone in Conservation Cost Sharing

The Kansas legislature recently appropriated $1 million for farmers and ranchers to carry out soil and water conservation work in the State, which is second in the Nation in cropland acreage.

The funds will be made available for cost sharing to landowners in late 1980 "for construction of enduring water conservation structures on privately owned land which are needed for development and improvement of the quality and quantity of Kansas water resources."

"In a time when tax dollars are very difficult to come by, we were most pleased that the legislature could see the need for this program," said Robert J. Binder of Hays, president of the Kansas Association of Conservation Districts (KACD).

"Conservation leaders in the State recognized the need for State assistance more than 10 years ago," noted Harold Johnson of Dwight, chairman of the State Conservation Commission, the State agency that will be administering the program. "And it has been a constant educational process ever since."

According to Binder, KACD and the commission formed a task force of two local conservation district supervisors from each of five areas in the State to analyze the need. The task force thoroughly analyzed the need and recommended State cost-sharing in the amount of $2 million a year.

The first step toward needed cost-sharing, Binder continued, occurred when the 1979 legislature authorized State cost sharing along with an increase in matching funds to counties for conservation district operations. He and other conservation district officials worked hard during the 1980 legislative session to get funding added to the authorization for State cost sharing. The effort had the full support of the Kansas Farm Bureau, Kansas Livestock Association, and the Kansas Committee of Farm Organizations.

"While only half the requested amount was authorized," Binder added, "we have our sights set on $3 million next year and a million dollar increase over each of the next 2 years. This funding is not to offset Federal cost sharing for conservation either. KACD will work as hard as ever to get adequate Federal funding. But we have opened the door for getting a significant amount of conservation work on the land."

"Cost sharing for conservation in Kansas will be a big step forward for soil and water conservation in the State and the Nation," Johnson added. "Federal budget pressures have been heavy, yet the cost of protecting our fragile soil and water resources is ever increasing."

Charles Bredahl of Topeka, executive secretary of the commission, reported that funds provided for the Kansas Conservation Water Resources Cost Share Program may be used for construction of terraces and diversions, waterways, water recovery and reuse pits, animal waste facilities, stockwater dams, and establishment of permanent vegetative cover on critical areas. The commission is now formulating rules and regulations to administer the program.

Fred Trump,
public information officer,
SCS, Salina, Kans.

Montana Legislature Funds Pilot Saline Seep Study

Correcting saline seeps, the problem of salt-ladened water seeping to the surface of productive nonirrigated cropland, is the object of a 2-year pilot project in nine north-central Montana counties.

Authorized by the 1979 Montana legislature, the goal of the project is to work with individual ranchers to reduce saline seeps by implementing techniques advocated by researchers.

With $241,000 from the State, a Triangle Conservation District was formed to coordinate the program. Individuals representing conservation districts in Pondera, Glacier, Toole, Teton, Hill, Liberty, Chouteau, Cascade, and Blaine Counties sit on the board of supervisors.

Ted Dodge, a Soil Conservation Service employee on an interagency personnel agreement with the Triangle Conservation District, heads up the project team.

Dodge says that saline seeps are a problem in Montana, North and South Dakota, and the Canadian Provinces of Alberta and Saskatchewan. "It is estimated that saline seeps have taken more than 200,000 acres of cropland out of production in Montana alone," Dodge says. "Seeps are increasing at about 10 percent per year.

"After developing a map which shows surface features of the seep area, we drill observation wells so we can monitor fluctuations in the water table. With the farming and cropping methods we recommend, the tables should go down and the seep areas recede," Dodge predicts. "Our goal is to do something about the problem, not just gather information."

The team works only with farmers who request help. Organized and fully staffed in January 1980, the team expects to work with about 100 farmers in the next year. The program ends in 1981 if not extended by the legislature.

Besides Dodge, the team includes Jane Holzer, a planner hired by the district to work with landowners, and Harry Brence, a drill rig operator. Assistance is also provided by SCS district conservationists and Extension Service county agents. Jim Krall, a cropping specialist with the Montana Agricultural Experiment Station; Marvin Miller, a hydrologist at the Montana School of Mines; and Paul Brown, a saline seep researcher with the USDA Science and Education Administration, also work with the team.

Cost sharing on some of the recommended practices is provided by USDA's Agricultural Stabilization and Conservation Service on private land and the Montana Department of State Lands on State-administered lands.

Brad Anseth,
public information officer, SCS, Bozeman, Mont.

City Swaps Land to Control Erosion

A 5-inch rain pours water and mud into home basements. Water and mud fill the heating ducts under the floor of a public school building. Inches of sediment cover several blocks of streets and sidewalks. And residents of Mapleton, Iowa, angrily ask about the State's erosion control law.

Upstream farmers have been asked to terrace their land but refused. The possibility of building a large water control structure just above the home sites was examined but not selected because of the high hazard to downstream owners. The situation is complicated further by the farmer's not wanting to sell 5 acres of his best land for the structure site. The city administration is not convinced of the seriousness of the problem.

That situation, not an uncommon one on rural-urban fringes in America, has been changed in Mapleton. Here is what was done: Mayor Merle Davis made a land trade to get city control of 50 acres of the 67-acre drainage area causing the problem. Slopes ranged from 5 to 11 percent.

The Soil Conservation Service recommended that the city build larger than usual broadbase parallel terraces with seeded backslopes on the 50 acres to store additional water. The terrace ridges were widened so that they could be safely used by snowmobiles. By building the terraces parallel, the city could continue farming the land for income. The other 17 acres were still privately owned cropland that were farmed up and down hill, with a fair to poor conservation tillage system. The tenant told Mayor Davis that the owner would not terrace.

To stop sediment from this area, a sediment and water control structure was built. A short diversion terrace now intercepts sediment and water from the unterraced land. The city watches it carefully and cleans out the sediment periodically.

The terraces and structure were built under contract after the city advertised and held a bid opening. The construction costs were shared by the Monona County Soil Conservation District from funds appropriated by the State of Iowa through the Department of Soil Conservation.

There will still be some runoff from the area in the spring when the terraces are full of ice and snow or when there is a high intensity rain. There will be maintenance costs. But there won't be the constant threat of mud-covered basements.

It is another in a long list of case studies in this country showing that what happens on the land can and does affect others, and that most of what we call "resource problems" don't have to be—if we can get people to act on them.

Bob Zimmerman,
district conservationist, SCS, Onawa, Iowa.

Iowa Vo-Ag Teachers to Promote No-Till

The Iowa Vocational Agricultural Teachers Association is working with a committee at Iowa State University in preparing instructional materials for vocational agriculture classes. They recently asked permission to use two Soil Conservation Service slide/tape shows on no-till.

They plan to convert the shows into filmstrips which will be provided to 225 vo-ag classes in Iowa.

The slide/tape shows are titled "No-Till in Sod" and "No-Till in Corn and Bean Residues." They were produced by Lynn Betts, SCS public information officer in Iowa. Much of the photography was by Gene Alexander of the SCS Midwest Technical Service Center, Lincoln, Nebr.

Both slide/tape programs were used extensively at no-till seminars for farmers last winter.

Jerry D. Schwien,
head, Information Staff, Midwest Technical Service Center, SCS, Lincoln, Nebr.

Manure's Biogas Powers Dairy Farm

by Lee B. Bentz

"I've been milking cows since I was 6 years old and had watched those bubbles popping in manure pits for years. I finally asked what they were, and someone told me 'methane,'" said Richard Waybright of Mason-Dixon Farms, Inc.

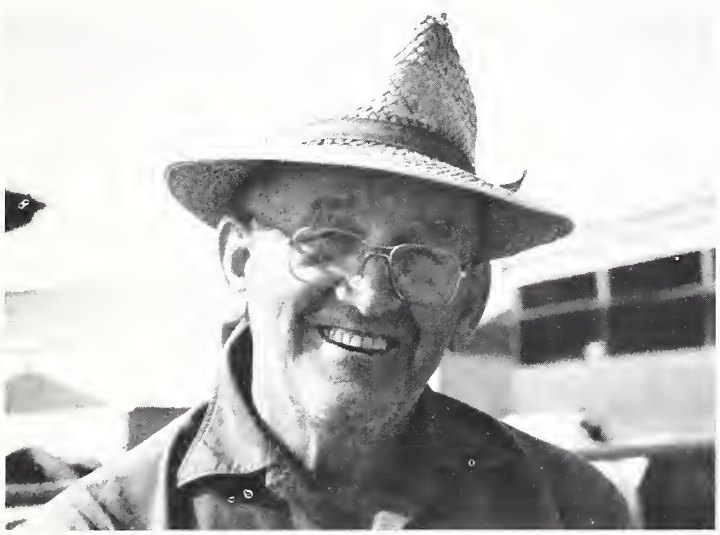
Mason-Dixon Farms is a corporate family enterprise operated by three generations of Waybrights in Adams County, Pa., about 7 miles south of Gettysburg on the Pennsylvania/Maryland border. Since October 1979, the Waybrights have been operating one of the first commercially successful methane gas digesters in the United States run on animal waste. The system is so successful that it produces most of the electricity used on the dairy farm, which has about 1,800 head of animals.

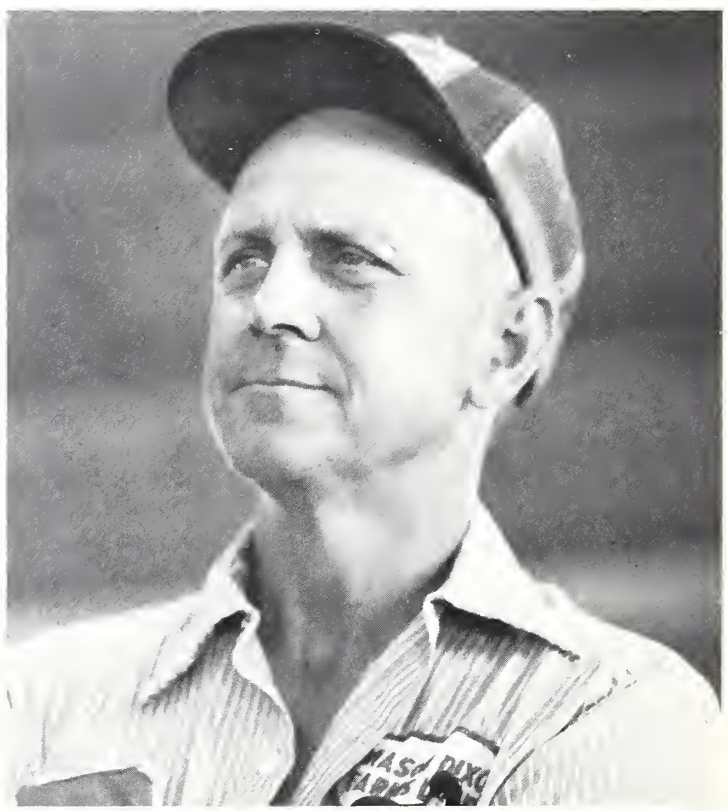
"About 8 years ago we heard how in India people had an energy system going in which they burned gas which was produced by animal manure," explained Richard Waybright, who is an Adams County Conservation District Director. "Since manure is one thing our farm has plenty of, I got to thinking that we could do something similar. I did some research and found a company that would help design and build the system."

Schaeffer and Roland, a Chicago-based firm, helped the Waybrights design a system with a guaranteed minimum production of gas over a 6-month period. Half their fee was to be paid when the first gas was produced, and the final payment was made when the minimum production was maintained for 6 months.

"Our cow barns are designed so that they are 12 feet lower at the end closest to the digester. We have a flushing system set up that is quite a labor saver. It takes one man only 20 minutes to go through all four barns and flush the manure down to the settling basin," said Richard. "We flush for 3 minutes twice a day while the cows are in place, and we use about 100,000 gallons of water each time. Grooves in the floor guide the water straight down to the other end of the barn.

"The flush water flows into the settling basin, and we draw all of the solids off—that's what goes into the digester," Richard continued. "The





There are three generations of Waybrights currently involved in operating Mason-Dixon Farms. Clarence Waybright, above, is the eldest and a great-great-grandson of the original owner. One of his sons, Richard, at right, is a director of the Adams County Soil Conservation District.

remaining water is pumped back to a 200,000-gallon water storage tank—all our water is recycled. To make up any water lost through evaporation, we collect runoff from the roof of one of the barns. We don't need to use well water.

"We used to drain the flush water and manure from the settling basin through a slotted dam, but we weren't getting all the solids out. We recently installed a vibrating screen to separate out the solids, which go into a pit before going into the digester. The screen will get more of the solids out, which will clean up the water for reflushing. The fine particles are better methane producers, too, because the finer the particle the more methane-producing bacteria can get around it."

The manure is pumped into the digester through a 6-inch pipe at the rate of 15,000 gallons a day. An equal amount of manure runs out by gravity at the other end. It takes 15 days for the manure to complete the cycle through the digester. The digester is 20 feet wide, 92 feet long, and 15 feet deep. It is constructed below ground for the insulation value of the earth and is covered with a nylon-reinforced rubber bag to collect the gas. The digester and gas bag are housed in a metal building. The gas is piped under 2 pounds of pressure from this building to an adjacent building housing a specially designed, diesel-powered Stewart-Stevenson electric generator. The gas passes through a meter to the diesel engine which powers the generator, creating electricity for the farm.

Biogas in its natural state contains about 600 BTU's (British Thermal Units) per cubic foot and is not "hot" enough to burn alone in the diesel engine. The Stewart-Stevenson engine is designed to run on 10 percent fuel oil and 90 percent methane or any combination thereof up to 100 percent fuel oil. If the digester fails—due to extremely cold weather, a hole in the collection bag, or some other reason—the engine automatically shifts to fuel oil, thus insuring a continued supply of electricity to the farm, an important consideration for the Waybrights with their automatic milking machines.

Twice a day the Waybrights flush the dairy barns with 100,000 gallons of water while the cows are in place.

The flush water and manure are collected in a settling basin located below the dairy barns.

Photos by Tim McCabe, except as indicated.

One key to the success of the system was finding a method of heating the manure in the digester without consuming most of the biogas. The problem was solved by installing a heat exchanger on the diesel engine which heats water that is circulated through the digester in pipes, thus maintaining the 95° F. temperature needed to promote the bacterial action to produce the biogas. This process uses about one-third of the heat produced by the diesel engine.

Another key to the success of the Waybrights' system is that the manure is moved to the digester within a few days.

"This digester was built for 700 cows strictly as an experiment. We didn't know if it was going to work or not," said Richard. "Now, we're planning to build a second digester and after we get it built, we will be producing about 1½ times the electricity that we use on the farm."

The Waybrights have already had an inquiry from Metropolitan Edison Electric Company about purchasing excess electricity.

Richard said that the system cost about $85,000 to construct, and that it will pay for itself in 2 to 3 years.

The watery end product of the digestion process is odorless—a definite plus in urbanizing and other sensitive areas.

"We squeeze all the water out of the spent sludge, and we use the solids as our sole source of bedding so we don't have to grow grain crops for bedding anymore," said Richard. "It has a lot better qualities than straw or sawdust. The methane-producing bacteria live on all types of virus and bacteria and die in the presence of oxygen, so when the manure gets to the other end of the digester, there are few harmful bacteria and viruses alive."

Also, sawdust has a very high level of bacteria and other organisms which cause mastitis in dairy cows.

The dried solids used as bedding are recycled through the digestion process.

The liquid is spray irrigated onto the farm fields. The Waybrights plan to install two center pivot systems to irrigate about 140 acres of corn and alfalfa with the liquid.

At left, Bert Waybright, one of Richard's sons, checks on the recently installed vibrating screen, which separates out the solids for use in the digester. The remaining liquid is piped to a holding pond then recycled as flush water.

At right, the manure is pumped into the digester through a 6-inch pipe at the rate of 15,000 gallons a day. The height of the nylon-reinforced rubber bag over the digester will vary depending on the demand for electricity. At times the bag is only 2 feet from the ceiling of the building.

"Fresh cow manure spread out on the field will go to a pH of about 4.5 in a couple of weeks. But it goes into the digester at a pH of 7," Richard explained, "and comes out at 7.5. It won't go acid so it actually has a neutralizing effect on the soil. It should reduce the need for lime which is a plus here in the Northeast where we usually have to add lime."

Another project the Waybrights are planning is an alcohol still.

"When we get our second digester built, we will have enough waste heat from the diesel engine to distill 40 gallons of alcohol an hour," said Richard. "In our operation the alcohol is going to be our byproduct. We're going to gear our fermentation and distillation to a brewer's yeast mash which will increase the protein value of our feed."

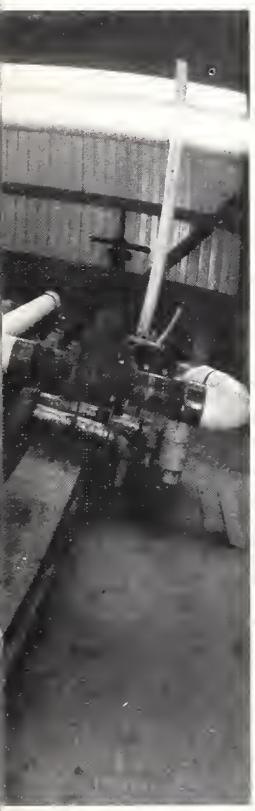
Schaeffer and Roland figure they can design an economical methane digester for dairy herds down to 150 animals. Richard Waybright says, "If I had only 50 cows, I'd still build one." Dairy, beef, and particularly hog operations should benefit from this technology. Hog manure has the greatest potential to produce biogas per unit of volume.

"Energy is becoming more and more a key economic factor. Take our farm for example," said Richard. "About 10 to 12 percent of our gross goes for energy, one source or another. If a farmer can reduce expenses by 10 percent, he might double or triple profit.

"There's an enormous amount that can be done in this country with renewable resources. If 60 percent of the animal waste in this country were run through digesters, it would be enough to reduce our imports by 30 percent.

"It makes a lot of sense for the farming units in this country to become energy self-sufficient," concluded Richard. "Then they won't have to wait for the tankers to come in to start planting."

Lee B. Bentz,
district conservationist,
SCS, Gettysburg, Pa



At right, after the manure comes out of the digester, the liquid is squeezed out, and the dried solids are used as bedding. The Waybrights no longer have to grow grain crops for bedding. The liquid is spray irrigated onto the farm fields.

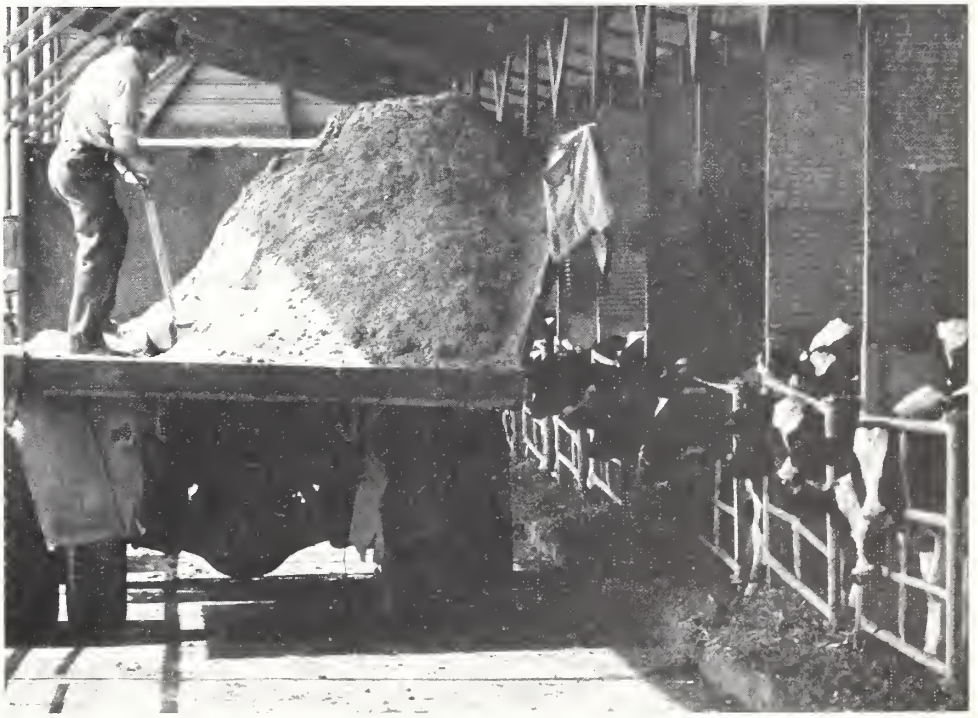


Photo by Lee Bentz.

Residues—Erosion vs. Energy

by Walter Martin

Under conservation tillage, crop residues left on the soil surface can conserve moisture, restrict wind and water erosion, and minimize environmental pollution.

Where on the Great Plains are all available crop residues needed to control erosion and restrict environmental pollution? Where might surplus residues be diverted as an alternative source of energy?

Research by USDA's Science and Education Administration (SEA) Soil Scientist Edward L. Skidmore, Manhattan, Kans., has produced preliminary answers to these questions.

Straw, small-grain stubble, and corn and sorghum stalks—the principal crop residues of the Great Plains—once were saved for livestock bedding and mulch or were plowed under.

Then USDA scientists took the lead in showing that crop residues are resources to be managed on the land. Under conservation tillage, crop residues can be anchored in the soil to conserve moisture, restrict erosion of valuable topsoil by wind and water, and minimize environmental pollution. Now these residues are being eyed as possible renewable replacements for fossil fuels.

Skidmore developed estimates of average annual residue production of principal crops in the 29 major land-resource areas of the Great Plains. This study broadly identifies crop-location combinations most likely to have residues surplus to needs for wind-erosion control that might be diverted as an energy source.

For individual situations, he is developing a procedure for predicting how much soil loss can be tolerated without impairing the land's productivity or contributing excessively to pollution. Once conservationists have a practical, precise way of making such estimates, they can more accurately identify residues surplus to conservation needs.

The first study involved a major part of 416 counties in 11 States. The

29 major land-resource areas of the Great Plains stretch from the Canadian border south to eastern New Mexico and central Texas, and east from the Rocky Mountain foothills some 400 to 600 miles.

Skidmore computed 1973-75 average yields of wheat, barley, oats, corn, and sorghum grain in each county, then calculated residue production per hectare based on grain yield. He then subtracted the estimated amount of applied residue that would be lost from tillage and weathering. The resulting residue estimates were compared with the amount needed to control wind erosion in each land-resource area as determined by computer solution of a USDA wind-erosion equation.

Residue needed was defined as what would restrict potential average annual soil loss by wind erosion to no more than 5 tons per acre each year on wide, smooth fields. Skidmore then classified the land-resource areas as deficit, residue surplus less than 1,000 pounds per acre, and surplus of more than 1,000 pounds per acre.

Wheat produces more residue than the other four main Great Plains crops combined. But more than 1,000 pounds of surplus wheat residue per acre can be expected only along the eastern side of the Plains from central Nebraska to central Texas, and in part of Minnesota's Red River Valley.

Wheat does not normally yield enough residue to control wind erosion in northern Montana, most of North Dakota, South Dakota east of the Missouri River, and on the western half of the Great Plains stretching from southeastern Wyoming south to New Mexico and west Texas.

Surplus corn residue of more than 1,000 pounds per acre can be expected, Skidmore found, in most of the Great Plains south of South Dakota. Corn residue deficit areas are in eastern Kansas, most of New Mexico, much of South Dakota, and in northern Montana and most of North Dakota where corn seldom is grown for grain.

Skidmore says oats, barley, and sorghum do not produce large quantities of residue in excess of what is needed to control wind erosion. These of course are broad estimates for large areas and do not take into account localized or field-by-field differences.

As an approach to estimating how much soil loss can be tolerated in individual fields, Skidmore proposes a mathematical computation based mainly on soil depth. He relates present soil depth to both a lower limit in depth, below which further soil loss would reduce productivity, and an upper limit beyond which increased soil depth would not add to productivity.

Also included in the calculations are the soil's renewal rate and an annual soil loss limit where damage costs to the environment become greater than costs of preventing the loss.

As an example, Skidmore applies his formula to a hypothetical soil situation.

Suppose soil depth is 4 feet. On this very deep soil, 3 feet is the minimum depth without loss of pro-

Skidmore's study identifies crop-location combinations in the 29 major land-resource areas of the Great Plains most likely to have residues surplus to control wind erosion.

ductivity, 5 feet is the maximum for increased productivity, soil renewal rate is 0.01 inches, and one-tenth inch is the soil loss acceptable for environmental reasons. In this situation, annual soil loss of approximately 6.5 tons per acre could be tolerated.

If soil loss is permitted to change according to the calculated tolerance, Skidmore says the amount lost would not be uniform from year to year. He calculates that soil depth would decrease rather quickly at first and decline to no change as soil loss tolerance approaches the soil renewal rate.

He says information not now available to scientists must be obtained before his soil loss tolerance computation could be put to practical use. More information is needed on renewal rates for specific locations and conditions, and how renewal rates can be accelerated. In addition, Skidmore says more insight is required into the depth that will support particular production levels as well as consensus on how soil depth would be measured.

Removal of crop residues as an energy source must be weighed against the need to maintain productivity and control erosion, Skidmore cautions. Up to 5 tons of soil per acre is lost annually by water erosion from two-thirds of the Nation's cropland. Fifteen percent of the cropland is losing more than 10 tons per acre. And wind erosion is the dominant conservation problem on about 70 million acres of land.

Walter Martin,
public information officer, SEA, Peoria, Ill.

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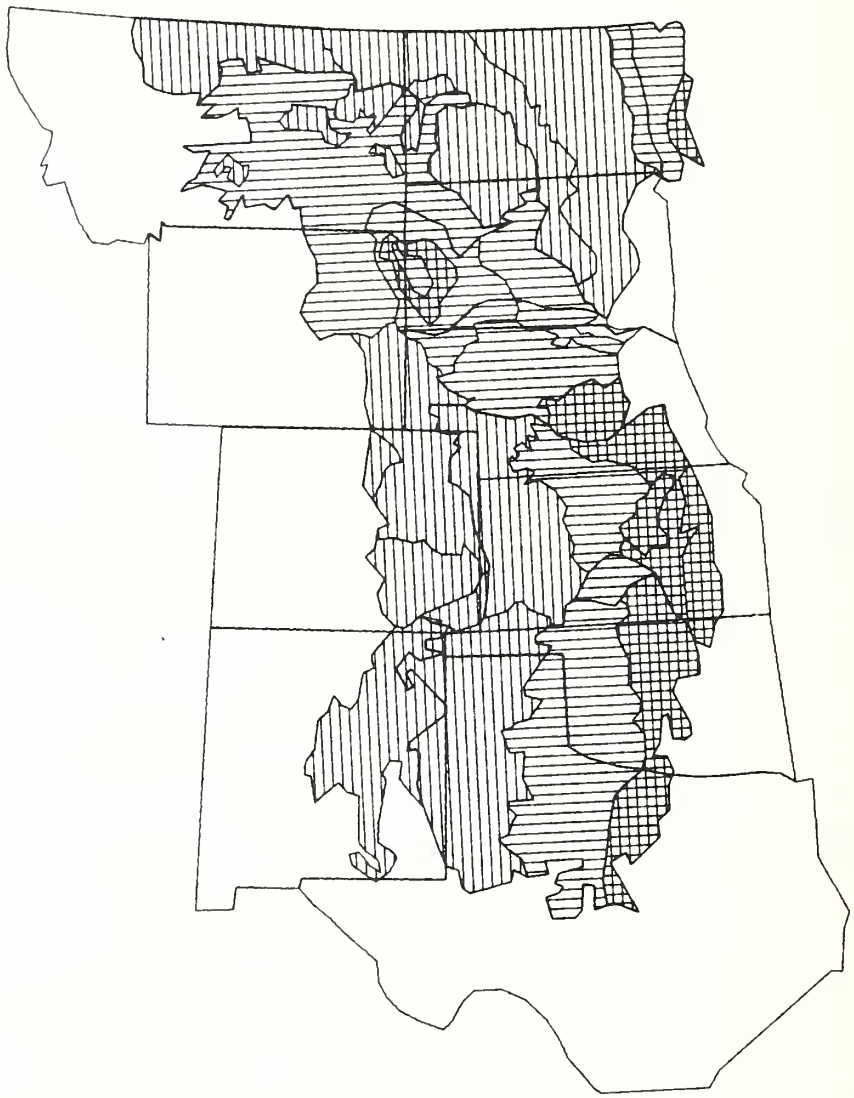

This figure shows area in the Great Plains where wheat residue, for the conditions of Skidmore's study, is deficit, has a surplus less than 1,000 lb./acre, and a surplus of more than 1,000 lb./acre for controlling potential average annual soil loss from wind erosion to 5.0 tons/acre/year on wide, smooth fields.

New Publications

Food or Fuel: New Competition for the World's Cropland

by the Worldwatch Institute

The following are excerpts from this report by Lester R. Brown:

"Throughout the period of intense agricultural modernization since World War II, U.S. Government programs to limit production have encouraged farmers to leave cropland idle. One effect has been to encourage farming practices that maximize output per acre of a particular crop rather than output per acre per year. With land now becoming scarce, the need to use land more intensively could lead to some fundamental shifts in cropping patterns. For example, one approach that would raise the output of land in an overall food-feed-fuel sense would be to double-crop the land with a winter food grain, such as wheat or barley, and a summer energy crop, such as sweet sorghum. Keeping the land covered with a crop for most of the year would both increase the percentage of incident sunlight converted into biochemical energy and reduce soil erosion.

"There is also a risk that the removal of large amounts of plant materials normally returned to the soil, such as cornstalks, could lead to a decline in soil organic matter and, therefore, soil fertility.

"Energy crops compete not only for land but also for agricultural investment capital, water, fertilizer, farm management skills, farm-to-market roads, agricultural credit, and technical advisory services. In the absence of a planned economy where all agricultural inputs are carefully controlled and clearly tagged for the production of either food or energy, it would seem to be impossible to launch a major energy crops program without siphoning resources away from food production. The assumption that energy crops will not compete with food crops may be both naive and politically risky.

"The question is not whether there should be an alcohol fuel industry. Clearly, there are many possibilities for converting agricultural wastes and other sources of plant materials into automotive fuels that need to be urgently pursued. At issue is whether governments can encourage the production of alcohol fuel without inadvertently launching an industry that competes directly with food production.

"If the potentially adverse effects of current programs to produce fuel from crops are to be minimized, several steps must be taken immediately. The governments launching these programs need to warn food-deficit countries of the potential reduction in exportable food surpluses so that they can adjust their agricultural and population policies accordingly. Secondly, the move toward energy crops reinforces the need for an internationally coordinated effort to arrest excessive erosion of topsoil. Without such an initiative, the widespread planting of energy crops will accelerate the deterioration of the world's cropland base. Where agricultural fuel programs are launched, priority in the use of fuel should be given to tractors and other farm uses over automobiles. And finally, a global food-price monitoring system that would be sensitive to the impact of alcohol fuel programs is needed. Such a system is essential if political leaders are to assess the worldwide impact of national energy crops initiatives on food prices."

Single copies of the report (Worldwatch Paper 35) are available for $2 from the Worldwatch Institute, 1776 Massachusetts Avenue, N.W., Washington, D.C. 20036. There are special prices for bulk orders.

Fuel From Farms, A Guide to Small-Scale Ethanol Production

by the U.S. Department of Energy

As stated in the introduction, "this guide has been prepared to meet the challenge of filling the information void on fermentation ethanol in a balanced, reasoned way, with emphasis on small-scale production of fermentation ethanol using farm crops as the source of raw materials. It is addressed not only to those in the U.S. farming community who may wish to consider the production of ethanol as part of their normal farming operations, but also to owners of small businesses, investors, and entrepreneurs.

"This guide presents the current status of onfarm fermentation ethanol production as well as an overview of some of the technical and economic factors. Tools such as decision and planning worksheets and a sample business plan for use in exploring whether or not to go into ethanol production are given. Specifics in production including information on the raw materials, system components, and operational requirements are also provided. Recommendation of any particular process is deliberately avoided because the choice must be tailored to the needs and resources of each individual producer. The emphasis is on providing the facts necessary to make informed judgments."

Copies are available for $4.50 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Specify Stock No. 061-000-00372-0.

Small-Scale Fuel Alcohol Production

by the U.S. Department of Agriculture

This technical manual examines the state-of-the-art of small-scale ethanol production technology and provides an economic assessment of the major annual operating variables that impact on fuel alcohol price and production.

Copies are available for $6 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (Stock No. 001-000-04124-0.)

Energy for Agriculture: A Computerized Information Retrieval System

by the U.S. Department of Agriculture, Science and Education Administration

This specialized bibliography on the subject of energy for agriculture contains 2,613 citations to the literature for 1973 through May 1979. Originally issued by Michigan State University, it is being reprinted and distributed by USDA as a companion piece to the Department's recently published volume, "Solar Energy and Nonfossil Fuel Research: A Directory of Projects Related to Agriculture, 1976-79." (Miscellaneous Publication 1378.)

Subjects covered in the bibliography include agriculture, conservation, irrigation, and tillage.

Free copies of either publication may be obtained by sending a self-addressed mailing label with request to: Library Operations Division, Technical Information Systems, USDA, National Agricultural Library Building, Beltsville, Md. 20705.

Synthetic Fuels Development: Earth-Science Considerations

by the U.S. Department of the Interior, Geological Survey

This illustrated report is useful to resource and range conservationists, engineers, geologists, biologists, agronomists, woodland specialists, and others who will be providing assistance in soil and water conservation programs as these energy sources are developed.

Copies are available for $4 from the U.S. Geological Survey, Branch of Distribution, 1200 South Eads Street, Arlington, Va. 22202.

CONSERVATION Research Roundup

Fuels That Don't Use Food

America may be starving for new forms of energy, but it does not want to create any starving mouths in the process of solving the problem. That is why the Federal Government is supporting research into the conversion of cellulose waste material from plants into fuel alcohols like ethanol. According to Dwight Miller, assistant director of USDA's regional research laboratory in Peoria, Ill., which is working on large-scale ethanol production, there has been some criticism voiced over the use of food products like corn for conversion into fuels. "Alcohol from cellulose waste materials like stalks has a terrific potential," he says, "and it will not be taking any food out of the marketplace.

"But," Miller warns, "the research into cellulose conversion is running about 5 years behind grain conversion."

Biomass as an Alternative Energy Source

Biomass—plant or animal material which can be used for fuel—could be Florida's "favorite alternative energy source," says Dr. Wayne H. Smith, coordinator of energy programs for the University of Florida's Institute of Food and Agricultural Sciences (IFAS).

"If any State in this country can grow biomass for energy, it should be Florida," Smith says.

"Florida has a climate for productivity that's unmatched and substantial land areas that could be devoted to biomass production," he said. These two resources are essential for "energy farms," one way proposed for obtaining large quantities of plant biomass.

In addition, Smith says, with 9 million residents and 40 million tourists, Florida must meet a high energy demand. Florida is now largely an importer of energy, producing only about 18 percent of the energy it uses.

Smith says weighty problems must be overcome before biomass can supply enough energy at a reasonable price to become widely used. However, he says he believes biomass could at least make Florida agriculture energy self-sufficient by the year 2000.

Biomass could supply enough energy to power much of Florida's food chain from farm to table, he says. The food chain currently consumes about 16.5 percent of the total energy nationwide.

At Florida's land-grant university in Gainesville and at research stations across the State, researchers are studying the feasibility of producing energy from a variety of biomass products. The biomass under study includes ordinary agricultural crops and their residues, trees, aquatic plants, and sewage.

What this potpourri of materials has in common is stored energy from the sun—energy captured by plants. Plants use light energy to make compounds which they then store in their tissues. Animal wastes also contain some of these energy-rich compounds, which are derived from their food.

When the biomass decays or is burned, energy is released. Fossil fuels are simply older, more concentrated versions of the same basic compounds which are found in biomass.

It is not always practical or desirable to burn biomass directly. "Most biomass as such is useless," Smith says. Usually, biomass must be converted to one or several intermediate stages before it can be used conveniently as a fuel. One important exception is with wood, which is still a major fuel worldwide.

"Historically, the principal use of biomass as a fuel has been direct combustion, and there will be a place for that in the future," Smith says. But now we have our biggest deficit with natural gas and gasoline, so there will have to be conversions to take biomass from solid to gaseous or liquid form, he says.

The most popular biomass-derived fuels today are ethyl alcohol—used in 10 percent blends with gasoline to form gasohol—and methane. Both these fuels come from biomass fermented by different processes.

Smith says biomass will probably not supply liquid or gaseous fuels at prices comparable to fossil fuels for at least several years.

One problem with making biomass fuels cheaply lies in the nature of biomass. Since plants usually capture and store energy from sunlight at efficiencies of 0 to 2 percent, large areas of land for growing biomass are necessary to harvest ample energy. It is estimated that a 100-megawatt biomass-fueled power plant would require from 16,000 to 32,000 acres of cropland, if 10 to 30 tons of biomass per acre were harvested each year.

Smith says aquatic biomass farming could be sustained by some of the State's lakes. Aquatic biomass is among the most productive biomass known, he says, adding that plants could also be grown in wastewater where they would produce biomass while improving water quality.

The environmental impact of large-scale biomass production must be considered, Smith says. Biomass farming should be compatible with other land uses as well as with human values, such as esthetics and environmental values, he says. Smith explains that environmental constraints will also dictate the amounts of biomass which can repeatedly be harvested from land without draining soil fertility or the water table.

Smith says he thinks biomass fuels can be economically produced as soon as efficient production and conversion systems are developed. He says not enough is known about growing biomass for energy, and that there is neither an extensive research record nor industry experience in the area.

Because of this, says Smith, alcohol manufacturers, who are the most visible producers in the biomass field today, may encounter problems.

Selecting and improving the most productive kinds of biomass are top priorities at IFAS. Smith says in several instances research has shown that when crops are grown strictly for biomass, yields have almost doubled.

Research must also be done to improve conversion methods, Smith says. "One of the things we're faced with right now is trying to adapt old technology that was developed for other purposes. For example, direct combustion of biomass was principally developed for waste disposal, and alcohol technology was developed for the spirits industry. Now we're talking about alcohol production as a fuel source. That's why we've established a bioconversion laboratory," he says.

Other factors "beyond biology" will determine how much of a contribution biomass will make as an alternative energy source, for example, what incentives are provided in governmental and agricultural policy, Smith says.

However, he says, "The real key to successful production of biomass will be a favorable energy balance." He explains that energy gained from producing and converting biomass must exceed the energy expended. "If you have to subsidize it a great deal, then it's not a feasible system," Smith says.

What kinds of biomass are feasible for Florida in the near future?

"Currently, we really have to look at the spectrum of crops with which we're already familiar and explore their potential as energy crops," Smith says. The plants in this category which appear most promising for Florida are sugarcane, sweet sorghum, and sweet potatoes, he notes.

Other promising candidates are plants which have low market value for food, feed, or fiber. These include several grasses, exotic trees, and even water hyacinths grown in sewage.

One whole category of biomass which is available now is waste—in the form of crop and forestry residue and manure. More than 2 million tons of this biomass are disposed of at cost in Florida yearly.

"Waste is the most profitable material to capture," says Smith, since it is a byproduct of other operations and the materials are frequently already collected.

Smith says biomass fuels will probably find their first widespread application on farms, partly because farms already have a surplus of wasted biomass. Later, he says, food farmers may also become energy farmers, producing enough energy for farm use as well as for food processing and distribution.

Fuel Beets Possible, Plant Scientists Say

Plant geneticists are working to develop what they call a fuel beet—a hybrid sugarbeet especially bred for use in making fuel alcohol.

Sugarbeets store 40 to 50 percent of their total weight as fermentable sugars, and this is 15 to 20 percent better than any other sugar crop, scientists say. Under today's conditions, this means that from 400 to 550 gallons of alcohol fuel can be produced from the average yield of each acre of sugarbeets.

Dr. Devon Doney and Dr. Clair Theurer at Utah State University believe a new type of sugarbeet is needed to yield even more fermentable sugars per acre. The two scientists have turned their attention to European fodder beets as one parent for a new hybrid line.

Fodder beets are high-yielding, low-sucrose beets used for livestock feed in Europe. Estimated alcohol yields from fodder beets are 20 to 30 percent higher than yields from the best U.S. sugarbeets, but the problem with fodder beets is that none of their varieties has any resistance to curly top, the number-one virus disease of beets in this country.

A cross between European fodder beets and U.S. sugarbeets could result in the fuel beet being aimed for. Such a cross should give large yields and some curly top resistance if curly-top resistant female parent plants are used.

Meetings

September

3–5	American Water Works Association, Chesapeake Section, Ocean City, Md.
5–7	American Agricultural Economics Association, Denver, Colo.
8–12	International Symposium on Inland Waters and Lake Restoration, Environmental Protection Agency, Portland, Maine
9–11	Timber Demand: The Future is Now, Forest Products Research Society, New Orleans, La.
16–20	American Horticultural Society, St. Louis, Mo.
17–19	National Waterways Conference, Tulsa, Okla.
21–23	The Fertilizer Institute, San Francisco, Calif.
21–24	American Fisheries Society, Louisville, Ky.
21–25	Interstate Conference on Water Problems, Cincinnati, Ohio
21–26	International Symposium on Nutrient Cycling in Agricultural Ecosystems, U.S. Department of Agriculture, Science and Education Administration, Athens, Ga.
23–26	National Conference on Editorial Writers, Huntington, W. Va.
24–26	International Association of Fish and Wildlife Agencies, Louisville, Ky.
28–October 1	American Forestry Association, Dixville Notch, N.H.
28–October 3	Water Pollution Control Federation, Las Vegas, Nev.

October

5–8	Society of American Foresters, Spokane, Wash.
6–11	Association of Interpretive Naturalists, Cape Cod, Mass.
11–14	Farm and Industrial Equipment Institute, Boca Raton, Fla.
14–16	Agricultural Research Institute, St. Louis, Mo.
19–23	1980 Congress for Recreation and Parks, Phoenix, Ariz.
20–23	National Irrigation Symposium, American Society of Agricultural Engineers, Lincoln, Nebr.
22–24	Hardwood Plywood Manufacturers Association, Scottsdale, Ariz.
23–26	National Association of Biology Teachers, Boston, Mass.
25–30	American Planning Association, Cincinnati, Ohio
27–28	Fundamentals of Ground Water Quality Protection, Pittsburgh, Pa.
27–31	American Society of Civil Engineers, Hollywood, Fla.

November

9–12	National Agricultural Bankers Conference, Dallas, Tex.
9–13	The Irrigation Association, Honolulu, Hawaii
10–17	National Grange, Cedar Rapids, Iowa
12–14	Future Farmers of America, Kansas City, Mo.
14–17	American Association of State Highway and Transportation Officials, Las Vegas, Nev.
16–19	American Society of Farm Managers and Rural Appraisers, Phoenix, Ariz.
16–19	National Association of State Universities and Land-Grant Colleges, Atlanta, Ga.
16–19	National Forest Products Association, Rancho Mirage, Calif.
16–20	American Institute of Chemical Engineers, Chicago, Ill.
17–20	Geological Society of America, Atlanta, Ga.
22–25	American Society of Landscape Architects, Denver, Colo.
30–December 5	American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, Detroit, Mich.

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